Factor Price Disparity in the Feeder Cattle Market and Retained Ownership Decision Making: An Application of Farm-Level Feed-Out Data

Brad J. White, John D. Anderson *

*Authors are assistant professor, Department of Veterinary Medicine, Mississippi State University and Associate Extension Professor, Department of Agricultural Economics, Mississippi State University

Contact: Brad White, PO Box 6100, Mississippi State, MS 39726-6100; Phone: 662-325-1114; Fax: 662-325-4548; email: white@cvm.msstate.edu

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Abstract

This study uses farm-level data from a university feed-out program to evaluate how the value of feeder cattle ultimately realized through finishing and grid pricing differs from their market value at public auction. Results indicate that uncertainty related to feedlot performance, final carcass merits, and fed cattle prices likely contribute to significant risk premiums in the feeder cattle market. This is consistent with the theory of factor price disparity. This result indicates that producers of cattle with known feedlot performance and/or carcass potential may be better off retaining ownership of their calves or marketing them in a way that communicates the information that is known about their potential performance directly to the buyer.

Introduction

The value of feeding and post-harvest information as a decision-making tool for cow/calf producers has long been recognized. Many land-grant universities around the country have developed programs to assist producers in obtaining such information. Typically, such programs consist of producers consigning a small number of cattle to a larger group that is fed out and processed. Carcass data is collected and returned to the producer along with information on feedlot performance. These programs have generally been billed as a means of obtaining information that can be used to guide production management decisions. In many cases, these programs pre-date the widespread acceptance of grid pricing. However, with value-based marketing (VBM or grid-pricing) becoming an increasingly popular marketing alternative, the value of the information obtained from these programs is potentially greater than ever.

Grid pricing – a system in which a price is determined for an individual carcass based on its quality grade, yield grade, and other relevant carcass merits – is an alternative to pricing cattle on an average liveweight basis that has become much more common in recent years. Grid pricing systems provide an incentive for fed cattle producers to deliver a high quality product (i.e., one that conforms to the product specifications embodied in the particular pricing grid). In the live weight system, an average price is paid for all the cattle while in a value based system cattle that meet or exceed the standards set forth in the pricing grid garner premiums. Producers can potentially realize increased income, but the potential for greater losses also exists if cattle do not perform as expected. For this reason, information on the potential carcass merits of cattle can be very useful to a producer contemplating pricing cattle on a grid.

The purpose of this paper is twofold. First, this research will demonstrate how feed out program data can be used in evaluating retained ownership decisions. To accomplish this objective, farm-level data from several years of feed-out program participation will be used to compare the market value of feeder cattle with their expected value as finished cattle in a grid pricing system. Second, this research will illustrate the magnitude of farm-level differences in both the level and variability of grid pricing returns. These differences highlight the usefulness of farm-specific information in evaluating marketing alternatives.

This research represents a unique contribution to the literature in a couple of respects. First, while a great deal of feed-out data has been accumulated over the past decade, it has been almost exclusively used to address production management issues. The application of such data to farm-level marketing decisions is unique. Second, a comparison of farm-level differences in grid pricing return distributions is rather novel, and it provides a much-needed caveat to the generalization of the results of previous grid pricing study results.

Review of Current Literature

The inability of the traditional live weight marketing system to effectively transmit market signals along the supply chain has been widely discussed in the literature (e.g., see Fausti, Feuz, and Wagner). The effort to establish a pricing system for fed cattle that is more consistent with consumer preferences has led to a rapid evolution in pricing methods for fed cattle. Schroeder et al. performed a survey of cattle feeders to evaluate the past, current, and predicted future marketing methods for fed cattle. In 1996, 82% of fed cattle were marketed on a live- or carcass-weight only pricing method, but by 2001 only 52% were sold using this method. Grid or value-based sales were 15.6% in 1996 and are predicted to be 62% by 2006. The change in

pricing methods represents a fundamental shift in valuation procedures of cattle potentially affecting all levels of the beef industry.

From an individual producer's perspective, differences between marketing methods for fed cattle should be understood and evaluated not only to permit an informed decision regarding the sale of finished animals but also to evaluate the impact of evolving fed cattle pricing arrangements on the value of feeder cattle. A considerable literature has developed over the past decade investigating grid pricing systems. The differences between grid and live weight pricing structures can be discussed in three main areas: economic return per animal, variability of income, and risk level for buyer and seller.

Economic Return based on Marketing Method

Different factors influence the final price and profitability derived for animals under live weight or grid pricing systems. Feuz, Fausti, and Wagner determine that average daily gain is the most important factor explaining profit deviations in cattle sold on a live weight basis while profit variability for grade and yield marketing is most influenced by quality grade.

Several authors (Anderson and Zeuli; Feuz, Fausti, and Wagner; Schroeder and Graff) compared the potential impact on economic returns of marketing animals on a live weight basis versus individual grid sales. Feuz, Fausti, and Wagner examined price distributions of 340 steers marketed live, dressed, or grade and yield. In this simulation, profits from selling cattle live were statistically lower than other methods.

Schroeder and Graff obtained data from 11,703 head from one feedyard marketed under a grid pricing formula through one packer at a rate of a little over one pen per week during 1997. They contrasted the grid prices received for the cattle to live and dressed weight prices

from the region for the time period described. Analysis revealed an average price of $65.60 / cwt if the cattle were sold live versus a mean live-equivalent value of $66.90 / cwt if the cattle were priced on the grid. The comparison also included simulating the ability to sort the cattle to the marketing channel with the highest return based on the carcass traits of the individual animal. They concluded that sorting cattle to the option offering the highest prices would increase income by $15 per head more than could have been made by selling on dressed price, $18 per head more than selling all on the grid and $35 per head more than live weight pricing. Grid pricing of animals with high quality grades created the highest returns in this pricing simulation, while cattle with low dressing percentage and low quality grades received the highest income on a live basis.

Anderson and Zeuli utilized simulated carcass data with various levels of predicted quality grading (45% to 95% Choice) within the pens and modeled grid pricing compared to live weight pricing over a period of historical market data from October 1996 to May 2001. Results revealed that regardless of pen quality levels examined, grid pricing generated greater revenue per head compared to live pricing.

The literature clearly shows that the same set of cattle may receive a different price (both dollar per hundred weight and total pen gross revenue) when marketed via live or grid pricing. The magnitude of the difference will be influenced by the specific traits of the cattle and the exact specifications of the individual grid used to price the animals. Evaluation of predicted differences in gross revenue for the sale group is critical when selecting a marketing method.

Income Variability

Schroeder and Graff compared variation in price from different fed cattle marketing methods. They found that 50% of the cattle received a price in a $2 / cwt range when sold on a live weight basis with a total range from $61.89 to $69.96. In contrast, when sold on a grid, just over 50% of the cattle received a price within $6 / cwt and had an overall range in live weight price per hundredweight from $44.46 to $80.69. They concluded that

> "Choice-to-Select boxed beef wholesale cut out price spread had the greatest impact on variability of price per hundredweight for carcasses sold on a grid followed by the variability in quality grade of carcasses in the pen."

As noted, grid pricing is based on carcass traits of individual animals. Individual animals, even within the same pen, can vary significantly in traits affecting grid price such as hot carcass weight, quality grade, and yield grade. Assigning worth to individual carcasses increases pricing accuracy, thereby resulting in greater price variability per pen (Ward et al.). An advantage of the increased variability offered in this system is greater accuracy in terms of price signals transferred to producers. A disadvantage of larger price distinctions based on quality as judged at harvest is increased risk for the seller.

Risk Effect of Pricing in Different Methods

There are two major types of risk associated with buying and selling fed cattle: (1) a general price risk inherent in a competitive market and (2) informational risk (Fausti and Feuz). Price risk is inherent in either live or value based marketing systems and is shared to some degree by both buyer and seller. Cattle feeders are exposed to significant economic risk due to high levels of variability in economic returns that are greatly influenced by variability in fed cattle sales prices (Mintert).

The pricing system for cattle at harvest dictates which party (buyer or seller) incurs the informational risk or the risk that the cattle will not dress and grade as expected. Animals sold on a live weight basis offer no negative risk to the seller, but this method places the buyer at risk that the carcasses will not perform as expected. The buyer assumes all negative impact of poor carcass performance, but may also realize increased compensation due to above average grading cattle. Conversely, when cattle are sold on a grid, the risk of quality and yield below expected levels shifts to the seller. The buyer will not over-pay for low value product and has low risk of poor economic outcome assuming base prices and adjustments are consistent with current market conditions. Traditionally, live-weight marketing of fed cattle carries low risk of price variation for the seller because they can accurately estimate the predicted final weight of the animals, and this is the main determination of gross revenue for the pen.

Several authors (Fausti and Feuz; Fausti, Feuz, and Wagner; Ward et al.) have suggested that informational differences between marketing alternatives generate uncertainty that affects behavior of market participants. Specifically, buyers may offer lower prices when purchasing pens of cattle on a live weight basis due to risk aversion. In essence, the buyer is charging the seller a risk premium due to the uncertainty of cattle performance. Fausti and Feuz describe this phenomenon as the theory of factor price disparity, which asserts that "a risk neutral firm will pay less for an input with uncertainty over its total product than it will pay for an input when its contribution to production is known with certainty." The price disparity caused by this uncertainty amplifies as available information to the buyer at the time of establishing a price decreases. Fausti and Feuz examine the impact of factor price disparity on prices at the fed cattle level. This concept also applies, however, to prices further up the supply chain.

Conceptual Model

Under the assumptions of perfect competition and a single variable factor of production (x), a firm's profit function is represented as

$$\Pi = p\,f(x) - r\,x - b, \tag{1}$$

where p is the value of the firm's output, $f(x)$ is the production function, r is the price of the single variable input, and b is the firm's fixed cost per unit. The first order condition for profit maximization holds that

$$\frac{d\Pi}{dx} = p\,f'(x) - r = 0. \tag{2}$$

This implies the familiar condition that the profit maximizing level of x is found where the value of the marginal product (VMP) equals the input price. In discussing fed cattle pricing methods, Fausti and Feuz note that where total product is uncertain, utility rather than profit maximization is the appropriate objective. They derive the following condition for utility maximization:

$$p\,E[vf'(x)] - r \;\; 0, \tag{3}$$

where v is a random variable with E[v] = 1. The sign of Equation (3) depends on the sign of the second derivative of the utility function. The key result is that where there is uncertainty regarding the total product of an input, a risk averse decision maker will purchase the input at a price that is less than its VMP.

In the feeder cattle market, cattle feeders formulate bids by estimating expected net feeding returns. The break-even price per unit of a feeder calf (*BE_FEEDER*) can be estimated as follows:

$$BE\_FEEDER = \frac{E[FED\_VAL] - E[TC]}{FEEDER\_WGT}, \tag{4}$$

where E[*FED_VAL*] is the expected gross value of the finished animal, E[*TC*] is the expected total cost of feeding the calf, and *FEEDER_WGT* is the current weight of the calf being purchased. Assessing the potential final value of feeder cattle, which are not even in the feedlot yet, through visual appraisal is clearly rather difficult. Moreover, additional uncertainty exists regarding the feedlot performance potential of feeder cattle, another important factor affecting their value. The foregoing conceptual model implies that risk averse feeder cattle buyers will build a significant risk premium into their bids in response to these uncertainties.

This study investigates the issue of factor price disparity at the feeder calf level. It is hypothesized that the "true" value of feeder cattle (i.e., the value derived from returns to fed cattle in a grid pricing system) will be quite different from the feeder cattle's market value (as determined in public auction markets). The primary reason for this is the tremendous uncertainty related to the feeder cattle's true value. This uncertainty results in part from price risk associated with future fed cattle prices, including grid premiums and discounts, but also from uncertainty related to the physical performance of the cattle.

From a feeder cattle producer's perspective, this is a very important issue. If, from past experience with the same or similar genetics and management, a producer knows with some degree of certainty that his cattle will perform well in the feedlot and/or in terms of carcass merits, then the market price may significantly undervalue those cattle. The producer would be better off to retain ownership of the calves or to market those calves through some alternative means (e.g., direct sales to a cattle feeder with knowledge the cattle's performance potential) in order to receive a price that more accurately reflects their potential value.

Carcass Data and Pricing Model

A data set of 2,763 calves fed in the Mississippi Farm-to-Feedlot program from 26 different farms over the period from 1993 to 2002 was evaluated in this study. Data included placement weight, slaughter weight, carcass weight, quality grade, yield grade, and total feeding costs. Animals that died during the feeding phase or had incomplete carcass data were removed from the set. Farms consigning fewer than 50 head to the program over the time period were also removed from the analysis, leaving 2,322 head from 13 farms. To remove the temporal bias of different phases of the cattle cycle, average prices over the period of 1993 to 2002 were used.[1] Not all of the calves in this study were harvested at the same time. For each of the 2,763 calves in this study, monthly average price from that calf's harvest month was used.

Opportunity cost of feeder calves was calculated for each animal using the animal's weight at placement and a weight-appropriate feeder calf price. Feeder calf prices consisted of mean October prices (in 50-pound weight increments) at Alabama auction markets from 1992 through 2001 reported by USDA Agricultural Marketing Service (USDA-AMS). Feeder calf prices are taken from the year prior to harvest to reflect the fact that all calves in the Farm-to-Feedlot program were placed on feed in the fall for harvest in the following spring.

Grid prices were derived from the USDA-AMS *Weekly Cattle Premiums and Discounts for Slaughter Steers and Heifers report*. The average premium or discount for each yield grade, weight, and quality grade was determined for each slaughter month and used for grid premiums or discounts. The weekly USDA boxed beef choice 550-850 pound cut-out value was used for the grid base price.

[1] Prices from 1993 to 2002 were used to reflect average prices over roughly a single cattle cycle. By not using prices after 2002, the market effects of recent North American BSE events (which began in Canada in May 2003) are excluded from this analysis.

In order to compare the average market value of feeder cattle (i.e., the opportunity cost of the calves) to their average "true" value (i.e., the net value ultimately realized through finishing and grid pricing the calves), the net value of the cattle through finishing/grid pricing was calculated as follows:

$$FC\_GRIDVAL = \frac{FED\_VAL - TC}{FEEDER\_WGT} \quad (5)$$

where *FED_VAL* is the gross value ($/head) of a finished animal priced on a VBM grid, *TC* is the total costs of feeding from feeder to finished weight, and *FEEDER_WGT* is the placement weight of the feeder calf.[2]

Differences between *FC_GRIDVAL* and the market value (i.e., opportunity cost) of feeder cattle are examined to determine the degree to which market prices in the feeder cattle market reflect the value of these feeder cattle ultimately realized through finishing/grid pricing. These differences are evaluated at the farm level to illustrate how individual producers might use this information in making decisions related to retained ownership of their calves.

Results and Discussion

Table 1 illustrates the summary of market price and grid-based feeder cattle value on all 2,322 feeder calves from all 13 farms. The average feeder calf market value displays relatively little variation with a range of $17.45 / cwt and a standard deviation of 3.17. Comparatively, the feeder calf value as determined by the grid pricing system was highly variable with a range of $115.00 / cwt and a standard deviation of $14.73. This difference in variability between feeder calf market value and the true value of the feeder cattle based on finishing/grid pricing returns

[2] TC includes interest charged over the entire feeding period on the beginning value of the feeder calf at the rate of 7% annually.

is quite large compared to the difference in variability of fed cattle values noted in previous research comparing returns from live weight and grid marketing of fed cattle (e.g., Schroeder and Graff; Anderson and Zeuli). This result underscores the notion that at the feeder cattle market level, uncertainty related to the "true" carcass value is much greater than at the fed cattle market level, due not only to uncertainty related to feedlot performance and carcass merits but also to price risk over the feeding period.

If something approaching the true feeder calf value can be derived from the grid price, this data reveals the imprecision of price signals communicated through the feeder calf market due to the significant risk premiums associated with both price and production uncertainty. As in the average pricing of fed cattle, differences between prices for individual feeder calves are not necessarily an accurate reflection of true differences in value. Graphically, the distribution of the grid-based values appears to be very close to normal, as would be expected since differences in value are largely due to differences in carcass merits. These carcass merits, in turn, represent the outcome of biological processes. By contrast, feeder calf market values are very tightly distributed and skewed to the left. (Figures 1 and 2).

The difference between the feeder calf market price and the grid-based feeder calf value averages $3.25/cwt with a standard deviation of $14.75. In fact, though the two series are valuing the same commodity, the correlation between the two series is quite weak (Pearson correlation coefficient = 0.102).

In summary, a significant disparity exists between the average feeder calf market price and the average value of these calves as an input to a finishing/grid pricing system. On average, the grid-based value of feeder calves from this study was $21.82/head greater than their market value. This implies that, on average, these producers would be better off retaining

calves and marketing fed cattle on a grid basis; however, a key issue that needs to be addressed is the large increase in variation of returns between the two marketing methods. This is most appropriately viewed on a farm-by-farm basis.

Price-Value Disparity Variation by Farm

As noted above, for the 2,322 calves examined in this study, the average grid-based value of individual calves is significantly higher than the average market value of individual calves. However, as Table 2 illustrates, the difference between grid-based feeder calf value and market value can vary significantly from farm to farm. Likewise, the level of variability in grid-based values can be quite different from farm to farm as well. In other words, variability in the physical characteristics of cattle as well as variability in feedlot performance will show up as differences in grid-based feeder cattle values. The less uniform calves from a particular farm are (in terms of their feedlot performance and ultimate carcass merits), the more variability there will be in the farm's grid-based feeder calf values.

Although the mean difference per hundredweight between grid-based and market value of feeder calves was $3.25, farms ranged from a difference of $-2.08 to a difference of $7.68 per hundredweight, as illustrated in Figure 3. This suggests that retained ownership with grid pricing may be more beneficial for some farms than others.

To determine whether or not retained ownership may be beneficial based on the past performance of the farm's calves, producers can evaluate the probability (based on historic production and price relationships) that grid-based feeder calf value will exceed current market value. Figure 4 illustrates this concept with cumulative distribution functions (CDFs) from two of the 13 farms evaluated in this study. CDFs in this figure plot the probability that the grid-

based value minus market value for a feeder calf will be below a given level. A value of greater than zero implies that retained ownership would be preferred to marketing feeder cattle. For Farm 3, the probability that calves will make less (on average) as finished cattle on the grid than they would make being sold as feeder cattle at market value is about 20%. On the other hand, for Farm 18 the probability of calves making less on the grid than as feeders is around 55%. Thus, retaining ownership and selling cattle on a grid appears, based on past cattle performance, to be a riskier prospect for Farm 18 than for Farm 3.

Summary and Conclusions

A great deal of previous research has explored differences between grid pricing and live pricing outcomes for fed cattle. This study examines how the value of feeder cattle as on input into a grid pricing system relates to their market value as feeder cattle. Data from Mississippi State University's Farm-to-Feedlot program is used along with historic feeder cattle prices and grid pricing information reported by USDA-AMS to quantify the difference between feeder cattle market value and grid-based value of the same feeder cattle. Results indicate substantial differences in the two values.

The findings of this study are significant in a couple or respects. First, while the relationship between average and individual prices for fed cattle has been widely explored, implications of individual pricing on the feeder cattle market have not been. These results reveal a fairly strong incentive for producers of above average quality feeder cattle to look for non-traditional marketing alternatives that will reward them for the quality of their cattle. Second, this study illustrates how feedlot and carcass performance information can be used as a tool for making marketing decisions.

From the firm-level perspective, information on the difference between feeder cattle market value and potential value in a grid pricing system represents a potentially useful decision-making tool. This study illustrates farm-level differences in the grid-based value of feeder cattle resulting from differences in the feedlot and carcass merit performance of the cattle. A farm manager with knowledge of past cattle performance can use that information to help assess the risk that feeder cattle retained into a feeding/grid pricing program would fail to receive a return equal to or greater than they could receive on the feeder cattle market. Similarly, farm managers who recognize that the value of their cattle in a feeding/grid pricing program is consistently higher than their market value as feeders can use that information to pursue other feeder cattle marketing alternatives (e.g., direct sales to feedlots) where the cattle could perhaps receive a premium for their potential superior performance.

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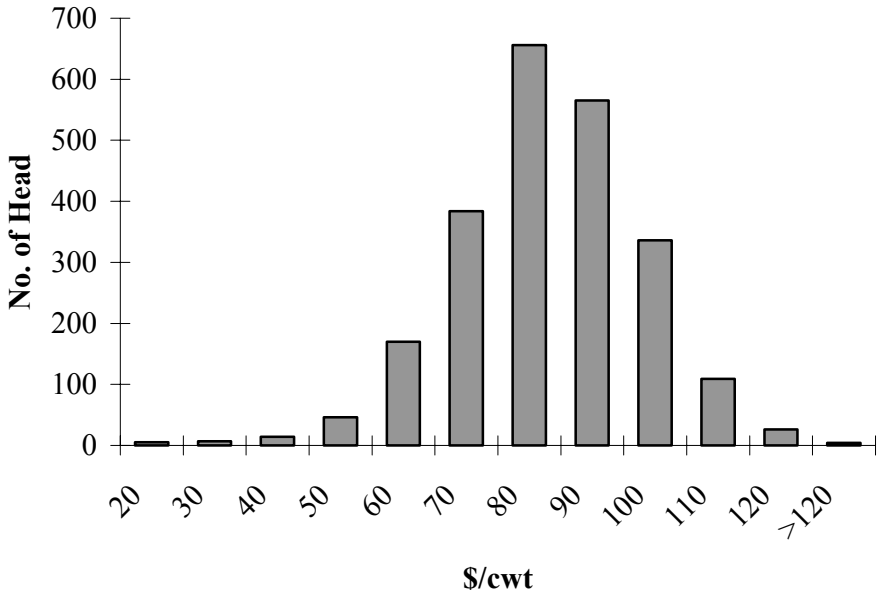
Table 1. Comparison of Feeder Cattle Market Price and Feeder Cattle Value Derived from Grid Pricing Returns

	Average	Std. Dev.	Minimum	Maximum
Feeder Calf Market Price ($/cwt)	$74.84	$3.17	$70.37	$87.82
Feeder Calf Grid Value ($/cwt)	$78.08	$14.73	$11.58	$126.58
Grid Value – Market Price ($/cwt)	$3.25	$14.75	-$63.73	$48.12
Grid Value - Market Value ($/head)	$21.82	$92.56	-$418.72	$271.88

Table 2. Farm-level Average Feeder Calf Grid-Based Values and Market Values

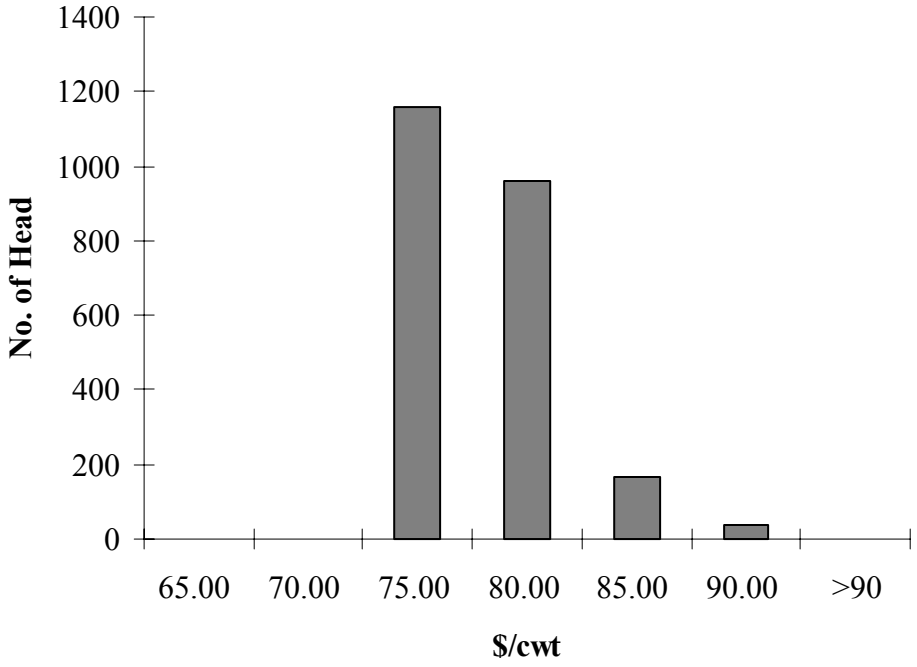
Farm ID	No. of Head	Feeder Price (Market) ($/cwt)	Grid Feeder Value ($/cwt)	Grid Value – Market Value ($/head)
3	163	74.78	82.45	48.98
		(2.45)	(11.47)	(72.30)
4	126	75.60	78.40	21.01
		(3.42)	(16.74)	(101.37)
7	303	75.95	77.50	10.77
		(3.21)	(15.04)	(91.35)
8	95	75.62	80.25	30.28
		(3.17)	(12.28)	(77.67)
10	83	73.16	78.31	36.03
		(2.57)	(12.04)	(81.59)
11	470	75.25	76.65	8.69
		(3.42)	(14.60)	(88.11)
14	51	74.23	77.07	17.34
		(2.84)	(13.39)	(79.87)
18	103	75.95	73.87	-13.56
		(3.13)	(16.29)	(95.30)
22	154	72.94	79.62	47.29
		(2.28)	(14.22)	(98.52)
23	56	73.01	72.81	-1.05
		(2.02)	(16.27)	(108.96)
24	665	74.47	78.56	27.72
		(3.03)	(14.99)	(95.14)
25	53	74.86	80.00	31.78
		(2.86)	(16.07)	(101.36)
Total	2,322	74.84	78.08	21.82
		(3.17)	(14.73)	(92.56)

Note: Standard deviations are given in parentheses below average values.



Note: Data include 2,322 feeder calves consigned to Mississippi State University's Farm to Feedlot Program from 1993 through 2002.

Figure 1. Distribution of grid-based feeder calf value



Note: Data include 2,322 feeder calves consigned to Mississippi State University's Farm to Feedlot Program from 1993 through 2002.

Figure 2. Distribution of feeder calf auction market values

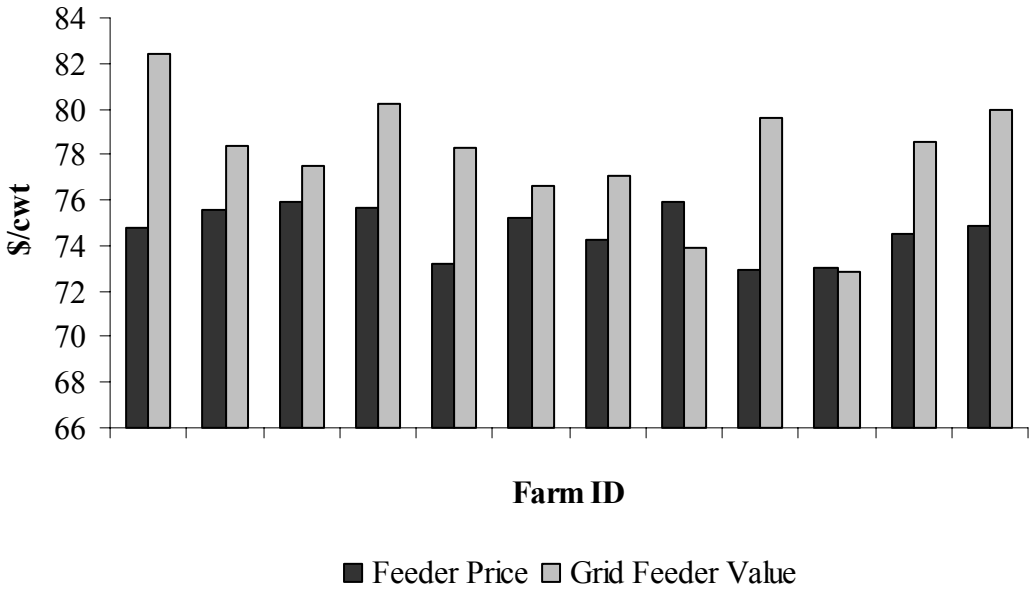


Figure 3. Feeder cattle market prices and grid-based values by farm: Mississippi Farm-to-Feedlot data, 1993-2002.

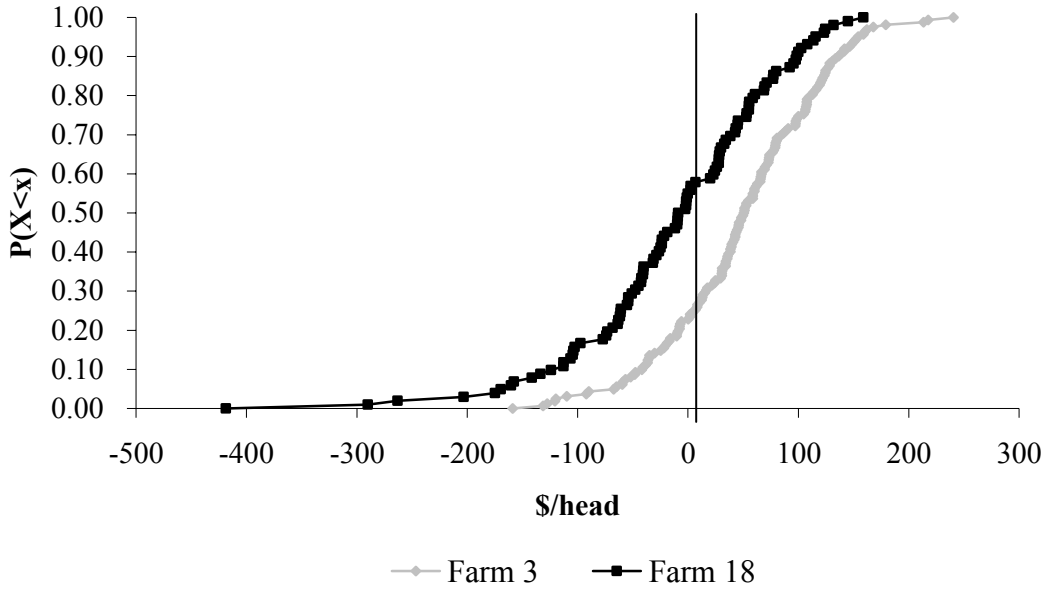


Figure 4. Cumulative distribution function of grid-based value minus market value ($/head)